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AVIACIÓN **C**IVIL

Report
IN-008/2020

Incident involving a Tecnam P2006T aircraft, registration LY-MEP, at the Castellón Airport (Spain) on 10 February 2020

GOBIERNO
DE ESPAÑA

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Notice

This report is a technical document that reflects the point of view of the Civil Aviation Accident and Incident Investigation Commission (CIAIAC) regarding the circumstances of the accident object of the investigation, and its probable causes and consequences.

In accordance with the provisions in Article 5.4.1 of Annex 13 of the International Civil Aviation Convention; and with articles 5.5 of Regulation (UE) nº 996/2010, of the European Parliament and the Council, of 20 October 2010; Article 15 of Law 21/2003 on Air Safety and articles 1., 4. and 21.2 of Regulation 389/1998, this investigation is exclusively of a technical nature, and its objective is the prevention of future civil aviation accidents and incidents by issuing, if necessary, safety recommendations to prevent from their reoccurrence. The investigation is not pointed to establish blame or liability whatsoever, and it's not prejudging the possible decision taken by the judicial authorities. Therefore, and according to above norms and regulations, the investigation was carried out using procedures not necessarily subject to the guarantees and rights usually used for the evidences in a judicial process.

Consequently, any use of this report for purposes other than that of preventing future accidents may lead to erroneous conclusions or interpretations.

This report was originally issued in Spanish. This English translation is provided for information purposes only.

Contents

Abbreviations

° ' "	Sexagesimal degrees, minutes and seconds
ºC	Degrees centigrade
ABM	Abeam
ADF	Automatic direction-finding equipment
AESA	Spain's National Security Safety Agency
AFM	Aircraft Flight Manual
AMM	Aircraft Maintenance Manual
APP	Approach control
ARC	Authorized release certificate
ATO	Approved training organization
CAMO	Continuing airworthiness management organization
CECOA	Airport control center
CPL	Commercial pilot license
CPL(A)	Commercial pilot license (airplane)
CRI	Class rating instructor
CTR	Control zone
DME	Distance measuring equipment
EASA	European Aviation Safety Agency
ELT	Emergency locator transmitter
FAA	Federal Aviation Administration
FI	Flight instructor
FI NIGHT	Night flight instructor
FOD	Foreign object debris
GPS	Global positioning system
h	Hours
HP	Horsepower
Hpa	Hectopascals
ILS	Instrument landing system
IR (A)	Instrument rating (airplane)
kg	Kilograms
KIAS	Indicated airspeed in knots
km	Kilometers
km/h	Kilometers/hour
kt	Knots
l , l/h	Liters, liters/hour
ICAO	International Civil Aviation Organization
LAPL	Light aircraft pilot license
LECH	ICAO code for the Castellón Airport
LH	Left hand
m	Meters
mm	Millimeters
m/s	Meters/second
m^2	Square meters
MEP	Multi-engine piston rating

METAR	Aerodrome meteorological report
MLG	Main landing gear
MTOW	Maximum takeoff weight
N	North
NAV	Navigation
NLG	Nose landing gear
OM	Operations Manual
PPL	Private pilot license
PTT	Push to talk
RH	Right-hand
RPM	Revolutions per minute
FFS	Firefighting service
SEP	Single-engine piston rating
T/O	Takeoff
TPA	Traffic pattern altitude
TWR	Aerodrome control tower
UTC	Coordinated universal time
V_{FE}	Maximum flaps extended speed)
VFR	Visual flight rules
VHF	Very high frequency (30 to 300 MHz)
V_{LE}	Maximum landing gear extended speed
V_{LO}	Maximum landing gear operating speed
V_{NE}	Never exceed speed
VOR	VHF omnidirectional range
V_X	Best angle-of-climb speed
V_Y	Best rate-of-climb speed
W	West

Synopsis

Owner and operator:	BAA Training
Aircraft:	Tecnam P2006T, registration LY-MEP, S/N: 098
Date and time of incident:	Monday, 10 February 2020 at 09:40 local time
Site of incident:	Castellón Airport (Spain)
Persons on board:	2, student pilot and instructor
Type of flight:	General Aviation – Instruction - Dual
Phase of flight:	Landing
Flight rules:	VFR
Date of approval:	03 June 2020

Summary of event

On Monday, 10 February 2020, a Tecnam P2006T aircraft, registration LY-MEP, made a landing with the gear not fully extended during the course of a training flight intended to practice takeoffs and landings at the Castellón Airport.

The crew were not injured and the aircraft sustained minor damage.

The investigation into the incident concluded that the probable cause of landing with the gear not fully extended was the failure to adhere to flight procedures, and in particular, the improper performance of the approach and final checklists.

The report contains one recommendation for the pilot training school that owns the incident aircraft.

1. FACTUAL INFORMATION

1.1. History of the flight

On 10 February 2020 at 08:40 UTC, a Tecnam P2006T aircraft, registration LY-MEP, owned by a flight school that operates out of the Castellón Airport (LECH), took off from the airport at 07:36 UTC on a training flight intended to practice takeoffs and landings.

After doing the first landing and takeoff without any problems, the crew proceeded to review the procedures once more as they prepared to land for the second time.

At that time, another aircraft, also on a training flight for another student at the same school, was preparing to make a solo flight. In order to facilitate the takeoff, the instructor decided to give priority to the solo student and they delayed their own landing.

After checking the actions required for the approach, as per the crew's statements, including confirming the three green position lights for the landing gear were on in the instrument panel, they prepared to land.

The landing was smooth and controlled, and as a result neither the instructor nor the student realized that the gear was not fully extended until they scraped over the runway. The instructor stated that he felt the tail contact the asphalt, and thought they might have had a tail strike, but he did not think the gear was not fully down until he felt the underside of the fuselage scrape the runway.

According to their statements, there was no kind of acoustic warning that the gear was up.

After the aircraft stopped, smoke appeared in the cockpit, so after securing it, they quickly evacuated. The occupants were not injured.

Photograph 1: Aircraft at the incident site

They checked the aircraft's status and saw that the MLG was completely retracted and the NLG was semi-retracted.

Underneath the nose wheel they saw a puddle of hydraulic fluid. They also saw that the left MLG wheel had scraped on the runway and that the underside of the fuselage was scratched, and that the antennas located there had detached.

1.2. Injuries to persons

Injuries	Crew	Passengers	Total in the aircraft	Others
Fatal				
Serious				
Minor				
None	2			
Total	2			

1.3. Damage to aircraft

The aircraft sustained minor damage as a result of the incident, specifically to the underside of the fuselage, the skin on the underside of the fuselage, the antennas located in this area, scratches on the hub covers on the MLG wheels and small dents in the MLG and NLG doors.

1.4. Other damage

None.

1.5. Personnel information

1.5.1. Flight instructor

The flight instructor, a 39-year-old Spanish national, had a commercial pilot license for airplanes, CPL(A), issued by Spain's National Aviation Safety Agency (AESA) on 14 February 2008 with the following ratings:

- Instrument, IR(A), valid until 30 September 2020,
- MEP (land), valid until 30 September 2020,
- SEP (land), valid until 30 September 2021,
- CRI – MEP (land) (class rating instructor, MEP (land)), valid until 30 June 2021,
- Flight instructor, FI(A), for PPL, CPL, SEP, MEP, IR, FI NIGHT, valid until 31 July 2020.

He had a total of 1500 flight hours, of which 78:30 had been on the type of the incident aircraft.

He had an English proficiency level of 4, valid until 8 April 2020.

He had class 1, 2 and LAPL medical certificates that were valid until 28 September 2020.

In the previous three days, the instructor had given classes to several students on the same type as the incident aircraft, totaling 15:05 flight hours and 46 landings.

1.5.2. Student pilot

The student pilot, a 23-year-old French national, was studying the integrated ATPL course and was in the final phase of multi-engine visual maneuvers before taking the test for the CPL license.

He had a total of 198:32 flight hours, of which 6:05 had been on the type with the same instructor as in the incident. He made a total of 25 landings with that aircraft.

He had a class-1 medical certificate that was valid until 17 April 2020, and a class-2 and LAPL certificates that were valid until 17 April 2023.

1.6. Aircraft information

1.6.1. General information

The Tecnam P2006T aircraft is designed and made in Italy by Costruzioni Aeronautiche Tecnam. It is a light aircraft with an aluminum fuselage, two engines mounted on a high wing, four seats (1 or 2 pilots and 3 or 2 passengers) and a retractable tricycle landing gear. It is EASA and FAA certified.

Fuselage:

- Length: 8.7 m
- Wingspan: 11.4 m
- Altitude: 2.85 m
- Wing surface: 14.8 m2
- Empty weight: 852 kg
- MTOW: 1230 kg

Photograph 2: Incident aircraft (file photo)

Powerplant:

Two ROTAX 912S3 engines.

- 4 stroke, 4 cylinders.
- Maximum power per engine: 100 HP.

Propellers:

Two MT MTV-21-A-C-F/CF178-05 constant-speed, variable-pitch propellers with a diameter of 1780 mm.

Fuel:

It has two wing fuel tanks, away from the engines, each with a 100-l capacity for a total of 200 liters.

The tank selection and cross-feed is controlled by way of two valves located on the instrument panel in the cockpit.

It uses AVGAS 100LL fuel.

Performance:

- V_{NE}: 171 KIAS
- V_{LO}: 93 KIAS
- V_{LE}: 93 KIAS
- V_{FE}: 122 KIAS (T/O position), 93 KIAS (fully extended)
- Flaps: 0º fully retracted and 20º±2º fully extended. Positions of selector lever: 0, T/O (take-off), Full (Landing)
- Climb rate: 5.8 m/s
- Range: 1250 km

Photograph 3: Position of the flaps after the incident landing

Instrument panel

Photograph 4: Instrument panel after the incident

Photograph 5: Position of landing gear lever

After the aircraft was evacuated, photograph 4, taken by the instructor, shows the following indications of interest to the investigation:

- Throttle levers full down, in the idle position.
- Propeller RPM levers full forward.
- Flaps up (0º).
- Position of landing gear lever: shown in greater detail in photograph 5, seems to indicate GEAR DOWN.

Antenna equipment on the aircraft

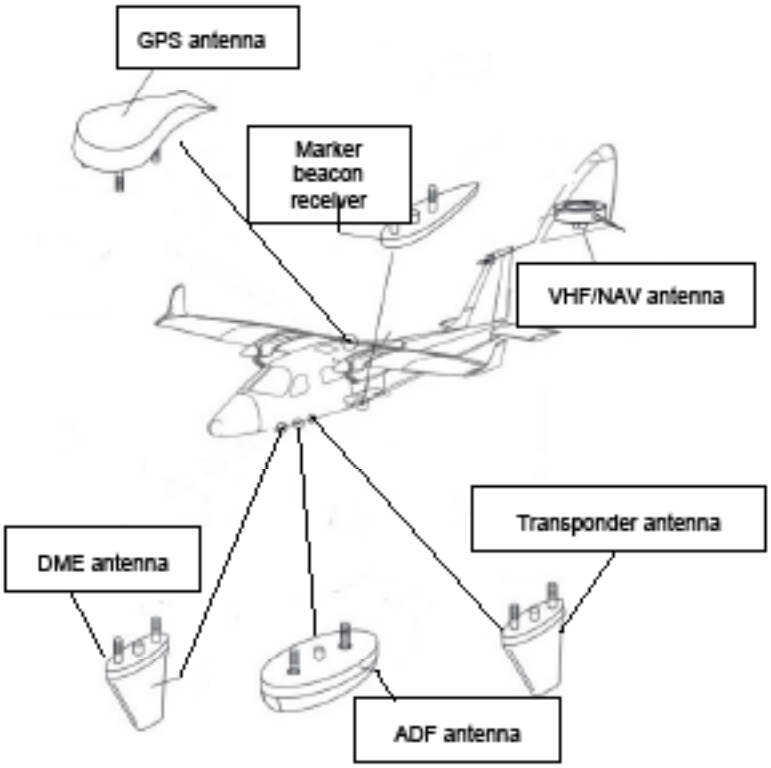


Figure 1: Locations of antennas

The locations of the various antennas installed on the incident aircraft are shown in Figure 1, and include:

- Underside of the fuselage: DME, ADF, transponder and a marker beacon receiver.
- Top of fuselage: GPS.
- Vertical stabilizer: VHF/NAV.

1.6.2. Aircraft's recent flight hours

The aircraft flew the following hours in February before the 10th, which is when the incident occurred:

Date	Flight hours	Landings
2020/02/01	02:35	11
2020/02/02	-	-
2020/02/03	-	-
2020/02/04	-	-
2020/02/05	04:45	20
2020/02/06	04:00	9
2020/02/07	04:06	9
2020/02/08	06:08	17
2020/02/09	02:00	7
2020/02/10	00:33	2
TOTAL	**24:07**	**75**

For the day of the incident, the flight school had scheduled the student pilot and instructor to do two consecutive flights with two different exercises, the first scheduled to last 1 hour and involving six landings, and the second, 55 minutes with seven landings. The incident occurred as they were preparing to make the second landing, 33 minutes into the first flight.

1.6.3. Maintenance history

The aircraft was manufactured in 2012 with serial number 098. Until January 2020, the maintenance was done by a maintenance center based in Sabadell (Barcelona) and approved by AESA as a continuing airworthiness maintenance organization (CAMO), and by EASA as a Part-145 organization. It was then replaced by another AESA CAMO and Part-145 organization that was based in Requena (Valencia).

The most recent maintenance checks performed on the aircraft by the initial organization had been as follows:

- 20 December 2019: with 2924:06 flight hours on the aircraft. Replacement of one of the green NLG-down indicating lights, P/N 60ZEN1-6, which was not working correctly.
- 30 January 2020: 50-hr check as per the approved maintenance program, Edition 3, Revision 3, with 2933:50 flight hours on the aircraft. Replacement of various components, such as the oil pressure gauge, sensors, etc., including the warning buzzer, P/N 457-021.
- 1 February 2020: replacement of the engine oil pressure gauge with 2942:26 hours on the aircraft.
- On 14 January 2020, with 2930:36 flight hours on the aircraft, the current maintenance organization replaced the NLG tire, this being the only task performed by the current maintenance organization before the incident.

At the time of the incident, the aircraft had a total of 2962:05 flight hours.

According to the maintenance program approved by the Italian authority, the maintenance checks of the aircraft have to be done as per the following table:

	A	B	C	D	E
Flight hours	First 25 h and every 50 h	100 h	600 h	1200 h	2000 h
Calendar interval	-	1 year	3 year	5 year	-

An analysis of the most recent scheduled inspections of the incident aircraft that affected the operation of the landing gear shows that the 50-h inspection does not require checking either the acoustic buzzer or the microswitches on the landing gear and flaps, while the 100-h and 12-month inspections involve a check of the complete landing gear system, including the acoustic buzzer and the hydraulic system in general.

The operational test verifies the smooth motion of the components, the operating speed of each unit, the effectiveness of the leg locking mechanism with the gear down, the operation of the warning buzzer, the operation of the indicating system, the separation of the tires in the wheel wells and the operation of the landing gear doors.

The microswitches are inspected during this check to ensure their safety, the cleanliness and general condition. The associated wiring is also checked to identify unwanted rubbing or improper routing.

1.6.4. Airworthiness status

Aircraft LY-MEP, serial number 098 and registered in Lithuania, according to the aircraft registry of the Civil Aviation Administration of the Republic of Lithuania, was registered on 27 June 2016 with registration number 01735. The operator is listed as the flight school involved in the incident, and the owner as a private company associated with said school.

The aircraft had Certificate of Airworthiness No. 01735, issued by the Civil Aviation Administration of the Republic of Lithuania on 3 June 2014 and valid indefinitely. It listed the aircraft as a "Normal Category Airplane". It also had an airworthiness review certificate, ref. ELSA-ARC-71, issued by an authorized maintenance center on 3 June 2019, with 2472 flight hours on the aircraft, and valid until 1 June 2020.

The aircraft also had the following authorizations:

- Noise certificate issued on 3 June 2014, valid indefinitely.
- Aircraft station license, ref. IR8640, issued by AESA on 27 February 2017 and valid until 26 February 2020, which included the communications and navigation units (VOR, GPS, DME and ADF).
- ELT registration card, valid indefinitely.

The aircraft had an accident insurance policy that was valid until 29 February 2020.

1.7. Meteorological information

1.7.1. General situation

At low levels, there was intense zonal circulation in the North Atlantic with deep low-pressure areas centered at latitudes above 60 degrees, promoting very widespread and intense zonal circulation that affected the northern Spanish peninsula. The remains of a cold front were moving along the region of Cantabria with hardly any precipitation, while the rest of Spain was under the influence of a high-pressure area that extended south of the 45N parallel from the Azores to the eastern Mediterranean. There was morning fog and stratus clouds on both plains, which dissipated throughout the morning.

1.7.2. Situation in the area of the incident

The records of the Castellón Airport contained the following AUTO METARs for the time period of the incident:

METAR LECH 100830Z AUTO 18005KT 9000 NCD 10/06 Q1029=

METAR LECH 100900Z AUTO 21003KT 180V250 CAVOK 12/08 Q1029=

(Interpretation: Castellón Airport, conditions described by the METAR on the 10th between 08:30 and 09:00 UTC: wind from 5 to 3 kt, temperature 10 and 12º C, high visibility, dew point between 6 and 8º C, and QNH of 1029 hPa.)

The aerodrome forecast (TAF) in effect was as follows:

TAF LECH 100500Z 1006/1106 19005KT 9999 FEW050 TX22/1014Z TN05/1006Z=

(Interpretation: Castellón Airport, conditions described by the TAF on the 10th at 05:00 UTC, forecast valid from the 10th at 06:00 UTC until the 11th at 06:00 UTC: wind from 190º at 5 kt, visibility in excess of 10 km, few clouds with bases at 5000 ft, maximum temperature of 22º C at 14:00 UTC, and minimum temperature of 5º C at 06:00 UTC.)

There were medium to high clouds in the vicinity of the airport, and light winds from the south on the surface. There was reduced visibility in the Duero and Tajo valleys, but not on the east of the Spanish mainland. Satellite images showed no other significant weather phenomena.

1.8. Aids to navigation

The flight was conducted under visual flight rules (VFR).

1.9. Communications

A summary of the transcripts of the communications between the TWR and the incident aircraft (LY-MEP), as well as with the aircraft that was preparing to take off, LY-FTP, as LY-MEP was approaching, is provided below:

- At 07:53:50, TWR confirms and clears LY-FTP to take off from runway 06, and it also communicates with LY-MEP to instruct it to fly "base left" due to another school aircraft that is going to take off from runway 06. LY-MEP confirms.
- At 07:55:05, TWR orders "base left" and confirmation on final. LY-MEP confirms and requests to vacate via E, which the TWR authorizes. LY-MEP confirms it will land on runway 06.
- At 07:57:22, noise is heard on the frequency, presumably caused by LY-MEP pressing PTT to broadcast, but stays silent for 6 seconds.
- At 07:57:28: LY-MEP calls TWR.
- At 07:57:34, LY-MEP says "We screwed up, we landed without the gear". TWR acknowledges and informs the CECOA and other traffic.
- At 07:57:59, TWR informs the CECOA of the event.
- At 07:58:53, TWR informs LY-MEP that it is coordinating the response.
- At 08:00:14, TWR informs the FFS to dispatch firefighters.
- At 08:00:29, LY-MEP informs TWR they have smoke in the cockpit.
- At 08:02:14, TWR informs LY-MEP that firefighters are entering the runway.
- At 08:10:33, TWR reports "the two pilots are OK, they don't have any problems, they exited under their own power. The aircraft, inside, smelled of smoke, looks like neither the front nor aft gear deployed, although the pilot stated that the light came on. Both gears are retracted and the airplane landed on the fuselage".
- At 09:57:00, LY-MEP makes contact and it is instructed to taxi on the runway and exit to the apron.
- At 10:04:07, TWR reports runway clear, emergency over.

1.10. Aerodrome information

The Castellón Airport (ICAO: LECH), also known as Castellón-Costa Azahar, is an airport that is located in the vicinity of Villanueva de Alcolea and Benlloch, in the province of Castellón (Spain).

It is at coordinates 40º 12' 35" N, 0º 04' 11" W.

It is at an elevation of 360 m and it has one asphalt runway in a 06/24 orientation that is 2700x45 m.

The airport is suitable for both VFR and IFR flights. It has air traffic control services and it features navaids (ILS and VOR). The airport is open from 06:00 until 22:00.

The school that owns the incident aircraft uses this airport as an additional base to provide initial pilot training. It has offices, classrooms and other facilities for both its personnel and maintenance personnel, as well as certain airport user rights as per a signed agreement.

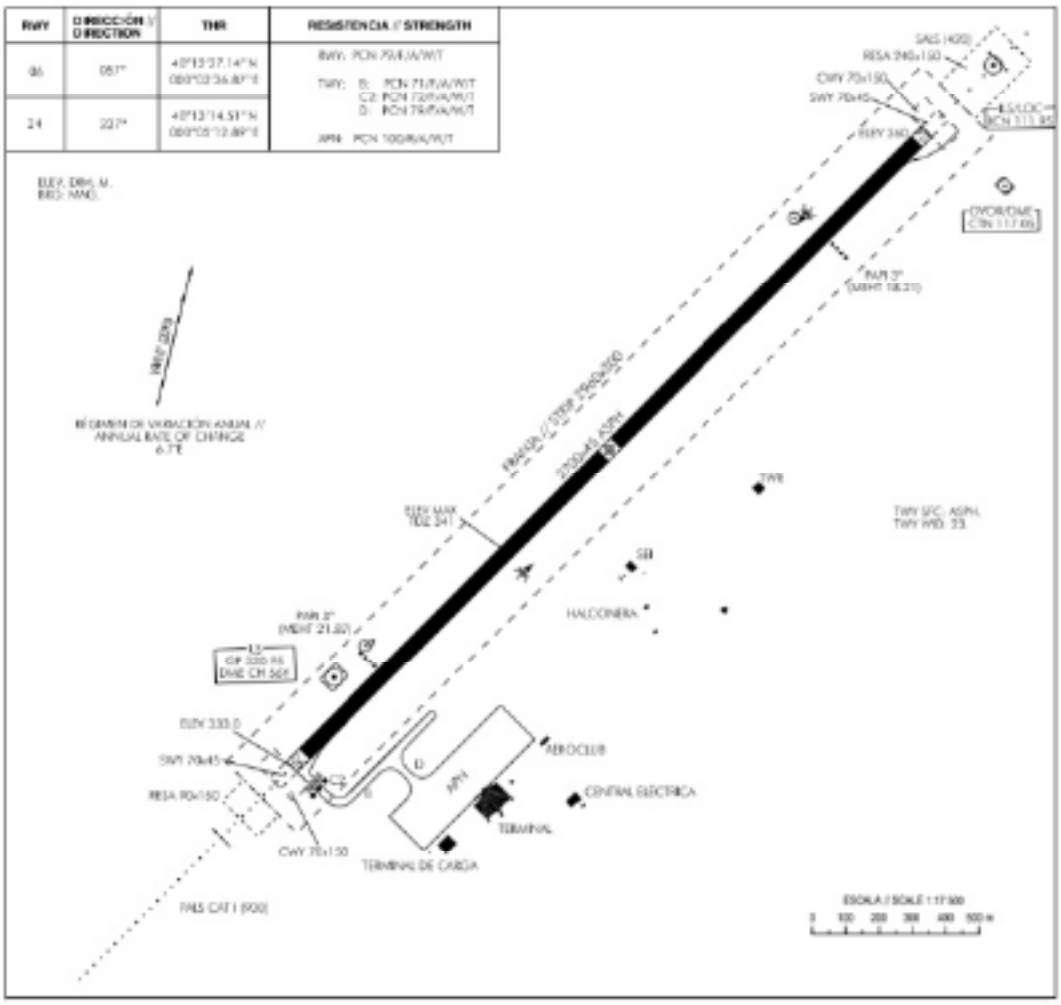


Figure 2: Castellón Airport chart

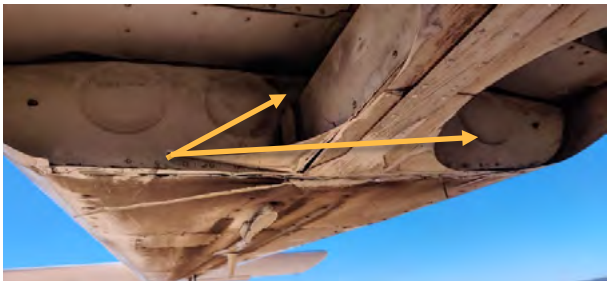
1.11. Flight recorders

The aircraft was not equipped with a flight data or cockpit voice recorder, since the applicable aviation regulation does not require this type of aircraft to have any recorders.

1.12. Wreckage and impact information

The aircraft landed on runway 24 with the gear semi-retracted. As a result, the damage caused as it traveled on the asphalt runway was primarily wear and abrasion of the underside of the fuselage all along the structure. The inspection conducted at the site of the incident revealed the following specific damage:

- The DME, ADF and transponder antennas, and the marker beacon receiver, located on the underside of the fuselage, detached during the aircraft's landing run and were deposited on the runway (photographs 9 and 10).
- Abrasions on the lower panels located between the LH and RH MLG wells.
- Horizontal abrasion on the tail tie-down bracket (photograph 7).
- Small fracture on the bottom of the right wing root (photograph 12).



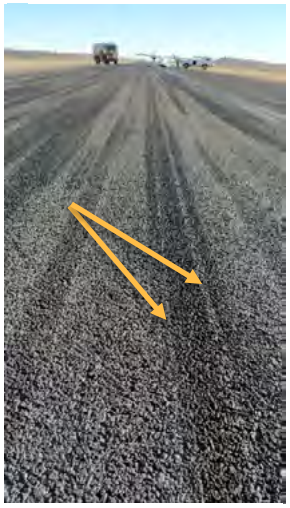
Photograph 6: MLG Wheel well

Photograph 7: Tie-down bracket on underside of tail

Photograph 8: Detached marker beacon receiver

Photograph 9: Detached antennas

Photograph 10: Antenna fragments on runway



Photograph 11: Paint marks on runway

Photograph 12: Damage to right wing root

- Abrasion and transfer of paint to the asphalt runway from both MLG wheel hubs. The right-wheel hub showed uneven wear, while the wear on the left-wheel hub was even (photographs 13 and 14).
- Small dents on the MLG wheel well doors (photographs 15, 16 and 18).
- Deformation of the left NLG wheel well door (photograph 17).

Photograph 13: Left wheel and hub

Photograph 14: Right wheel and hub

Photograph 15: Bent left MLG wheel well door

Photograph 16: Bent right MLG wheel well door

Photograph 17: Bent NLG door

Photograph 18: Closed position of bent left MLG door

1.13. Medical and pathological information

Not applicable.

1.14. Fire

Not applicable.

1.15. Survival aspects

Not applicable.

1.16. Tests and research

1.16.1. Statements

1.16.1.1. Instructor's statement

According to the information provided by the instructor, the incident flight was a training flight scheduled for 07:30 UTC whose purpose was to review and perform the general checklists and to practice takeoffs and landings at the Castellón Airport.

They did the pre-flight check, which was actually performed by the student pilot by himself, who found no problems. The level was refilled, with 0.4 l added to the tank in the left wing.

Cleared to taxi to the runway 06 holding point, they started the engine and requested clearance to do takeoffs and landings. They did the initial takeoff at 07:46 UTC, which was uneventful, followed by the planned checklists and the first landing. They then took off again with no problem.

The tower asked them to report on the left downwind leg on runway 06. Another school aircraft was taxiing to line up and wait on runway 06, so they adjusted the traffic pattern to facilitate its takeoff, since it was a solo flight by another student.

According to the instructor, when ABM of the threshold, as specified in the AFM, they lowered the flaps to the T/O position, reduced their speed below 96 kt and lowered the landing gear.

After doing these steps, they turned to the downwind leg, adjusted their speed to 90 kt and the student read the checklist to then turn on the base leg. Once established on final, the instructor stated that the student said "three green, flaps down, fuel pump on, landing light on, touch and go, clearance received". The student then read the checklist and continued.

They did the approach at 85 kt. Once over the runway, they started the flare with the engine at idle.

Suddenly, the instructor stated that they began to hear a scratching noise, and his initial thought was that they had had a tail strike, but they quickly realized they were landing without the gear down. The instructor's initial reaction was to ask the student what he had touched. At the same time, he looked at the position of the landing gear lever and it was in the DOWN position.

Some smoke then penetrated the cockpit and the instructor secured the aircraft by closing the fuel valve, contacting the tower, turning off all electrical components and both engines.

At 08:06, they evacuated the aircraft uninjured.

In his statement, the instructor noted that the warning buzzer did not sound at any point.

1.16.1.2. Statement from the student pilot

In his description of the event, the student pilot stated that the flight began at around 07:00 UTC, once the airplane was prepared, since it was the aircraft's first flight of the day. He visually inspected the airplane and deemed it to be in suitable conditions for flying. The oil and fuel were checked and drained as appropriate.

He started the engines at 07:30 UTC and taxied to the holding point to warm up the engines. By around 07:40 UTC, the airplane was ready to start the flight. The plan was to make two takeoffs and landings and then leave the CTR to perform some maneuvers.

The did the first landing without incident. The second approach was set up with the flaps in the T/O position and approach for landing. During the downwind leg over runway 06, he did the approach checklist and briefing. Over the threshold, he stated that he performed the final approach checklist, including selecting the flaps and moving the landing gear lever to the DOWN position.

It was in this configuration that the entered the final leg for runway 06. Once over the runway, he again said "down 3 greens, flap set, fuel pump on, landing light on, touch and go, clearance received". He specifically stated that at no time during the approach did the buzzer sound to indicate that the gear was not down. They landed, secured the airplane on the runway and asked the tower for assistance.

1.16.2. Related reports/communications

1.16.2.1. Report from the Airport Coordination Center (CECOA)

In its daily log on the day of the incident, CECOA provided the following information on the incident:

- 08:50[1] h Runway incident involving TWR report that a small plane had landed without the landing gear. FFS and Maintenance informed to try to raise the airplane and clear the runway.
- 09:05 h The pilot reported smoke in the cockpit. Reported to FFS, which confirms there was no fire and that the aircraft was on the runway without the landing gear down.
- 09:25 h Crane arrives to move the airplane.
- 09:56 h Crane arrives at entrance guardhouse.
- 11:15 h Airplane on stand, runway free from FOD and operational.

1.16.2.2. Report from Airport Control Service

The statement from the log of the Airport Control Service reported the following with regard to the incident:

- At 07:58 UTC: aircraft LY-MEP, while doing a touch and go at 07:56, landed with the gear not deployed. An emergency was declared and the emergency management protocol was executed and coordinated with the necessary personnel. The pilot initially reported no personnel injuries. Another aircraft, LY-FTP, on the left pattern for runway 06, was informed of the emergency and instructed to circle on downwind until the emergency was resolved. Finally, with assistance from a crane, the aircraft was raised and the gear lowered, after which the airplane taxied off the runway under its own power. The emergency was declared over at 10:04 UTC and the runway was opened at 10:17 UTC.

The controller on duty stated that he had nothing to add to this information.

1.16.3. Tests/Inspections

In light of the statements from the crew, as well as the findings identified when inspecting the aircraft after the incident, it was deemed necessary to evaluate:

- The procedures relevant to the maneuvers performed.
- The actuation and operation of the landing gear by doing an operational test of the system.
- The damage to the aircraft after the incident.
- The operating procedure specified by the approved training organization (ATO) for "touch and go" maneuvers.

[1] All times are UTC.

1.16.3.1. Actuation and operation of the landing gear

As part of the investigation, a general visual inspection of the aircraft was performed at the site of the incident, and the steps needed to check the operation of the landing gear and its indicating, alarm and emergency systems were carried out.

Mechanically, the gear was operational and worked properly, as did the emergency gear extension system and the indication and warning systems.

1.16.3.2. Technical assessment of the damage to the aircraft

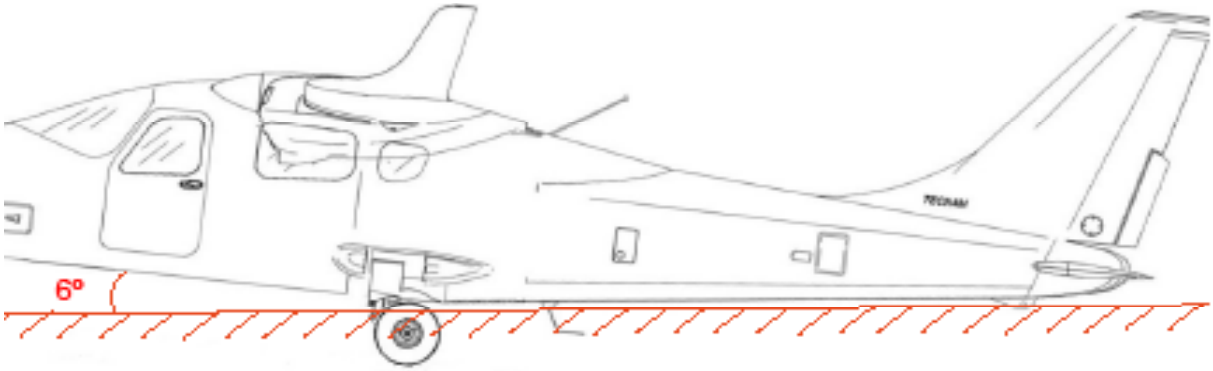
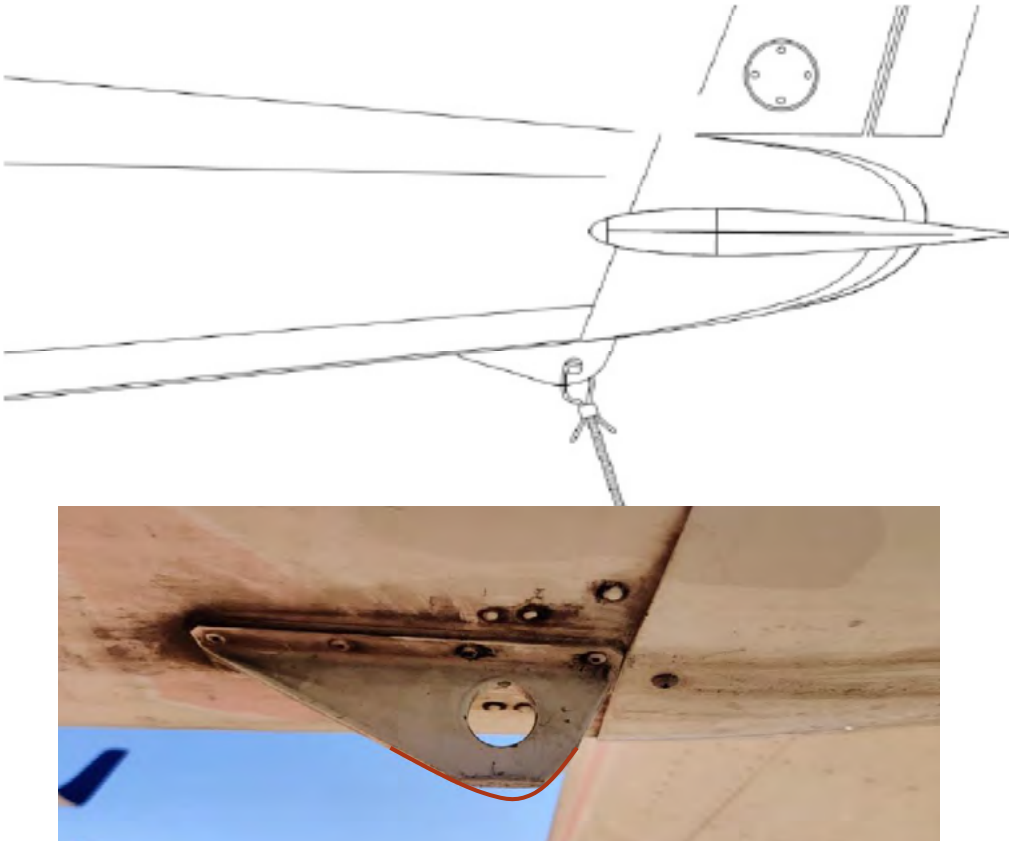


Figure 3. Position of the aircraft upon contacting the runway



Photograph 19. Tie-down ring on the underside of the tail cone

The abrasion experienced during the landing by the tie-down bracket, located on the underside of the aircraft's tail cone, due to friction with the runway, shows a lack of material in this component, as evidenced by photograph 19. The original outline of this bracket is indicated by the red line traced out over this component in its final state.

1.16.3.3. Information on the operating procedure of the approved training organization

According to the Operations Manual of the ATO that owned the incident aircraft, its operating procedures refer to the procedures in the aircraft's AFM.

In terms of instructor flight hours, the ATO's OM specifies that they may fly 12 hours in a 24-h period or 60 hours over seven consecutive days.

In the three days prior to the incident, the instructor had given classes to several students on the same aircraft type as the one involved in the incident, flying a total of 15:05 hours and making 46 landings over the course of the three days as follows:

- 7 February 20: 3:30 flight hours and 14 landings.
- 8 February 20: 6:30 flight hours and 12 landings.
- 9 February 20: 5:05 flight hours and 20 landings.

1.17. Additional information

Not applicable.

1.18. Useful or effective investigation techniques

Not applicable.

2. ANALYSIS

2.1. Analysis of the weather situation

The weather conditions at the Castellón Airport at around the time of the incident were suitable for flying. There were no meteorological phenomena, visibility was good and there were no other unforeseen circumstances that may have contributed to the incident.

2.2. Analysis of the aircraft wreckage

The analysis of the debris from the aircraft after landing on the runway at the Castellón Airport shows that the aircraft landed without the MLG down and with the NLG semi-deployed.

The minor damage to the doors of the MLG wheel wells, due to their shape and to being bent in the direction of motion, indicates that it was caused by minor contact between the ends of the doors and the runway.

The wear on the underside of the fuselage, as well as the loss of the antennas located there (DME, ADF and transponder, as well as the marker beacon receiver), were due to landing on the runway with the underside of the fuselage with the gear not deployed.

The minor damage to the NLG doors indicates slight contact between them and the runway, which confirms the nose-high attitude of the airplane for much of the landing run due to the NLG being semi-deployed.

The white paint that was deposited on the runway during the landing was the result of the MLG wheel hubs being dragged on the asphalt. Since the MLG did not deploy, and since the wheels are, by design, not covered, both the wheels and the part of the hub that protrudes the most are exposed to the outside. The friction with the runway left them, on both the right and left sides, practically equally abraded, although the hub on the right wheel exhibited an area with no wear, which indicates that it was slightly more retracted into the wheel well and not in contact with the runway. The white paint marks on the runway were parallel and extended for the duration of the landing run.

The tie-down bracket on the underside of the airplane's tail cone was also abraded by the constant contact with the runway for almost the entire duration of the landing run. Based on the crew's own statements, this was the first point on the aircraft to make contact with the runway. Moreover, the way in which the material was lost, horizontally and uniformly, indicates that the aircraft was in a nose-up attitude, some 6º based on the design of the structure, and that the aircraft contacted the runway in level and controlled flight. This part also deposited paint and material on the runway, leaving a noticeable mark.

After the landing, the position of the gear lever was in the DOWN position, according to the crew's statements, although this could not be confirmed since the instructor, after securing the aircraft and stopping the engines, immediately arranged for the aircraft to be moved in order to clear the runway. He had a crane raise the aircraft and he actuated the emergency gear lowering system. This explains why the hydraulic accumulator of the emergency system did not have adequate pressure when the aircraft was inspected. As per his statement, he did not allow the system to lower the gear by gravity; rather, he manually forced the gear down and locked it. The gear lever was thus in the DOWN position. He checked that the gear was operational and carefully started the aircraft and taxied it to the stand assigned by the airport, where it was parked for an inspection.

During the inspection conducted by this Commission, the landing gear was verified to be working by cycling it several times. This confirmed that the gear was fully operational, and there was nothing to indicate that it was not operating properly at the time of the incident. However, there is always the possibility of a random failure of the microswitches and/or of the acoustic warning system, although in light of the tests performed, this is considered unlikely.

When the gear is lowered and raised, the nose gear is the last to extend and retract, taking on average 6 to 8 seconds more than the MLG. This means that the situation in which the MLG was retracted and the NLG was semi-deployed could have been reached in one of two possible ways:

1. The gear was down and the landing gear was selected to UP, after which enough time elapsed before contact was made with the runway for the MLG to completely retract (about 20 seconds), slightly bending the wheel well doors, and the contact with the runway abrading the wheel hubs and transferring the paint to the runway. The contact with the asphalt is what allowed the gear to remain in its housing, with presumably no impact to push it into its housing, since the marks on the tires and hubs did not exhibit the large deformations that would have occurred if the gear had impacted the runway while semi-deployed. It seems obvious, however, that the nose gear did not have enough time to fully retract (an additional 6 to 8 seconds), meaning that the nose wheel made contact with the runway with the gear semi-deployed, and remained like that, unable to retract, until the airplane came to a stop. The total landing run lasted a minimum of 28 seconds and covered approximately 936 m, if the landing was made at 65 KIAS, as specified in the landing procedure. This is consistent with the marks on the runway and with the position where the aircraft stopped.

2. The gear was retracted and the gear lever was hastily selected to DOWN very close to the runway, such that when the MLG tried to deploy, the immediate contact with the asphalt prevented it due to the weight of the airplane, keeping the MLG legs in the wheel wells and slightly bending the small wheel well doors and

abrading the underside of the fuselage as a result of contact with the runway for at least 20 seconds. This is the length of time needed for the NLG to start to deploy, which is in fact what happened, but without sufficient time for the NLG to fully deploy (which would have required 6 to 8 more seconds) due to the change in the airplane's attitude. This attitude was at least 6° nose-up until the NLG touched down on the runway, as evidenced by the wear on the tie-down bracket on the tail cone, as explained in section 1.16.3.3. The lack of space would have prevented the NLG from fully extending. The total time that elapsed between the tie-down bracket making contact with the runway and the airplane coming to a stop was approximately 22 to 24 seconds. At a speed of 65 KIAS, this implies a landing run of about 800 meters.

Assuming the gear was operational at the time of the incident and that no random failures occurred involving the microswitches or the warning system, the most likely conclusion of the above analysis is that when the tie-down bracket made contact with the runway, the crew realized that the gear was not down and, thinking there was enough time to lower it, hastily moved the gear to the DOWN position, by which time it was impossible to execute a normal landing.

2.3. Analysis of the operation

As stated in the previous section, it is likely that the gear extension cycle was started but not completed. This could have been for one of two reasons: the crew moved the gear lever to the DOWN position very close to the runway, meaning the mechanism did not have enough time to completely extend the gear; or, the system failed and the gear lowered but did not lock, as a result of which the legs retracted upon contacting the runway. This latter case is considered unlikely, since the impact with the asphalt would have caused damage to the legs and more damage to the fuselage and wheel hubs, which was not the case. Therefore, the possibility that the gear was lowered but did not lock due to contacting the runway is ruled out.

The crew stated that they saw the three green landing gear lights on, which indicate that the gear is fully down and locked. This information is incompatible with the fact that the MLG was fully retracted and the NLG semi-deployed, unless the indicating lights were malfunctioning and remained on without the gear being down. The indicating lights were verified to be working correctly during the operational check.

In reality, for the position the gear was in after the landing, the light that should have been on was the amber gear-transit light, which turns on when the gear is in the process of extending or retracting. This could not be checked since the position of the gear was changed after the incident and the crew assured that they saw three green after landing.

In addition, as explained throughout this report, this aircraft has an acoustic system to warn the pilots if a landing is being attempted with the gear not in the down and locked position. The system is activated if the crew retards at least one of the throttle levers to idle and/or the flaps are fully extended with the gear in the UP position. This acoustic warning system was verified to be working during the operational check of the system. Since the crew stated that they did not hear any kind of acoustic warning during the approach, it may be concluded that neither throttle lever was at idle, that the flaps were not down or that the gear was down. This last possibility is obviously ruled out, given the position of the gear after the incident.

Accordingly, it is unlikely that the crew saw three green lights on in the cockpit if the gear was not down and locked. The fact that they did not hear the acoustic warning could have been due to the aircraft's mode of operation during the landing.

If the pilot does not cut the throttle to idle during the approach, meaning a power-on approach is made, this allows for a shallower approach angle. This type of approach results in a much easier flare for a student pilot to execute, since all the pilot needs to do is cut the throttle to idle over the runway and slightly lift the nose of the airplane to land. This technique in and of itself is not problematic (in fact, it is used for heavier airplanes), but using it removes protective barriers, such as the crew forgetting to lower the landing gear.

As a result, it is advisable to fly the approach by cutting the throttle at a point that allows the aircraft to glide to the runway. This would make it possible for the acoustic annunciator warning that the gear is not down to activate early enough so that the gear can be lowered before reaching the runway.

Another aspect to consider in the landing operation is the fact that the student pilot was preparing to make his second touch and go that day, on which he had planned to practice this maneuver, when another aircraft of the school appeared, and to which the instructor gave priority, as it involved a solo flight by a student.

This could have disconcerted the student pilot, who had initially correctly executed the checklist, verifying that the three green lights were on. But after the change in plan forced him to execute the checklist again, he may have unwittingly actuated the lever again, this time retracting the gear.

It is therefore likely that there was a loss of situational awareness by the student pilot and improper oversight by the instructor involving the position of the landing gear during the approach. Since the acoustic warning was not activated, likely due to the fact that the pilot was flying a power-on approach, said position was not noticed until the final moment, when the aircraft's tail impacted the runway as the throttle levers were moved to idle once over the runway and the aircraft's nose was raised slightly (about 6º), which caused the tie-down bracket to make contact with the asphalt.

2.4. Analysis of the aircraft's maintenance

The inspection of the aircraft and the analysis of the maintenance records available show that its overall conditions from a maintenance standpoint was acceptable.

Specifically, the operational check of the landing gear and its indicating and warning systems did not reveal any faults and the system worked correctly.

As for the most recent maintenance activities involving the landing gear indicating and warning systems, which are the ones that exhibit the greatest inconsistencies between the checks made during the inspection of the aircraft and the crew's statements, some 38 hours before the incident flight, the green landing system indicating lights were replaced because they were not working properly. Moreover, in the most recent 50-h scheduled check, done about 29 hours before the incident flight, the acoustic annunciator was replaced, in addition to other components.

Nothing indicates that these elements were not working correctly, considering that the check performed by this Commission did not find any malfunctions in these systems. Furthermore, the airplane had flown 29 hours since the last maintenance activity without any malfunctions being reported in any of these components.

2.5. Analysis of the organization and maintenance

The instructor had flown several consecutive training flights in the days before the incident. This could have led him to lower his guard when supervising a student that, in his own words, was "exceptional" and whom he trusted enough not to fully supervise while in flight, as evidenced by the fact that the student did the pre-flight check by himself. Despite the student's competency and abilities, the fact is that he had flown very few hours on the aircraft type, and giving way to another aircraft during the approach could have made him lose focus, resulting in not following the proper procedure and not adequately checking the actions to carry out, including checking and confirming that the gear was down.

According to the ATO's OM, the instructor's duty and rest times were in keeping with the OM requirements. Although the instructor noted that he had made a large number of takeoffs and landings in recent days, the fact remains that the rest criterion is based on flight hours and not the number of landings, meaning the requirements were satisfied.

In fact, the instructor commented that perhaps on this occasion, with this particular student pilot, whom he specifically trusted given his excellent record, he relaxed his oversight when verifying if the landing gear lights showed that the gear was down and locked, and although he was adamant that the three green lights were on during the approach, prior to the maneuver to give priority to the other traffic, he could not assure they were on just prior to the final landing.

According to the information provided by the organization, there was no written procedure in the training manual specific to touch-and-go maneuvers, meaning that the aircraft's checklists were used. A suitable procedure adapted to the type of aircraft involved in the incident, a light, twin-engine aircraft, could help ensure that these maneuvers are carried out more safely.

3. CONCLUSIONS

3.1. Findings

- The flight instructor had a commercial pilot license, CPL(A), with MEP (land), SEP (land), IR (A), CRI (A) and FI (A) ratings, and flight instructor ratings for PPL, CPL, SEP, MEP IR, FI NIGHT, all of them valid.
- The instructor's class-1, class-2 and LAPL medical certificate was valid.
- The instructor had a total of 1500 flight hours, of which 78:30 had been on the type.
- In the previous 3 days, the instructor had gone on training flights with several students on the same type of aircraft, flying a total of 15:05 hours and doing 46 landings.
- The student pilot was taking the integrated ATPL course and was in the final phase of visual maneuvers in multi-engine aircraft in preparation for taking the CPL license exam.
- The student pilot had a valid class-1, class-2 and LAPL medical certificate.
- The student pilot had a total of 198:32 flight hours, of which 6:05 had been on the type, all with the same instructor as on the incident flight, doing a total of 25 landings with that aircraft.
- The aircraft was owned by a Lithuanian pilot training school based in Castellón that offered ATPL/CPL courses.
- The aircraft was maintained by an AESA and EASA Part-145 maintenance center that had a valid certificate whose scope included the type of aircraft. After 1 January 2020, it was replaced by another center with analogous authorizations.
- The aircraft had a valid certificate of airworthiness for the operation.
- The aircraft was manufactured in 2012 and had a total of 2930:36 flight hours.
- The last scheduled maintenance inspection was a 50-h check carried out on 30 January 2020, with 2933:50 flight hours on the aircraft.
- The weather conditions were not limiting for visual flight.
- The inspection and functional check of the landing gear, its indication and acoustic warning systems, as well as of the emergency extension system, revealed that they were all working properly, and identified no operational faults.
- The NLG extends and retracts after the MLG.
- The MLG takes 20 seconds to extend, and the NLG takes an additional 6 to 8 seconds.
- The acoustic buzzer that warns the pilot that the gear is not down is activated if either thrust levers is in the IDLE position and/or the flaps are extended.
- An analysis of the damage to the aircraft shows that the landing was done with the MLG retracted and the NLG semi-extended.
- The investigation revealed that the aircraft first made contact with the runway with the tie-down bracket at a nose-up angle of about 6º. During the landing run, the antennas and marker beacon receiver located on the underside of the fuselage detached, and the tires and hubs on the MLG wheels were abraded.

- The instructor's supervision of the student's actions during the approach and landing was inadequate, as he did not verify that the landing gear was down before touching down.
- The instructor properly controlled the aircraft after touchdown and brought it to a stop.
- The damage to the aircraft was not consistent with the crew's statements.
- There was no written operating procedure to confirm the actions taken by the student pilot and the instructor during touch-and-go maneuvers performed on aircraft with retractable landing gear.
- The student pilot and instructor were uninjured and were able to exit the aircraft under their own power.

3.2. Causes/Contributing factors

The investigation into the incident identified as the probable cause of landing with the gear not fully extended as the failure to adhere to flight procedures, and in particular the incorrect execution of the checklists during the approach and on final.

4. SAFETY RECOMMENDATIONS

REC 17/20: It is recommended that BAA Training develop training procedures for practicing touch and go maneuvers that ensure they are performed safely.

5. ANNEXES

5.1. Specific information on the aircraft's landing gear

The retractable landing gear on the Tecnam P2006T is hydraulically actuated by a reversible electric pump. The structure is made of high tensile strength alloys of aluminum and steel, and is directly attached to the main bulkheads on the fuselage. An oil-air damper provides the necessary load absorption.

The main gear is actuated by an aluminum pushrod that is connected to a hydraulic piston. The gear is equipped with Cleveland wheels (6.00-6) and brake pedals.

The gear is retracted by rotating the legs 90º toward two modules on the side of the fuselage outfitted with two small doors, although most of the gear, including the wheels, is housed in wells in the fuselage with no covers.
The nose landing gear has one wheel (5.00-5) and a telescoping arm with an oil-air damper. It is connected to the first bulkhead in the cockpit by a steel frame. The gear is operated hydraulically by a trailing arm, which also doubles to lock the gear in the down position. When lowered, the nose wheel connects to the rudder pedals by way of several pushrods.

The system has a series of indicating position lights (down and locked or in transit) and an acoustic warning buzzer that informs the pilot that the landing gear is down/up.

There is also an emergency system that allows the gear to be deployed manually under the force of gravity if the main system fails.

5.1.1. Landing gear hydraulic actuation system

The hydraulic system that drives the retraction and extension of the landing gear is in fact an electrohydraulic system that is powered by the reversible electric pump, which is controlled by a switch on the lever in the instrument panel (gear control panel) and by microswitches in the gear legs.

These microswitches detect the position of the landing gear, whether it is fully down and locked, or retracted. The pilot is alerted using an audible buzzer if the approach and landing configuration is incorrect – in terms of the flap position, the throttle lever and the landing position – in order to avoid unwittingly landing with the gear up.

The hydraulic system has two modes of operation: normal and emergency. When operating normally, the hydraulic system lowers and raises the landing gear by means of hydraulic actuators, with gravity aiding when lowering the gear. When operating in emergency mode, the gear can only be lowered by way of a hydraulic accumulator that discharges pressurized hydraulic fluid to the aforementioned actuators. The emergency

controls consist of two hydraulic distributors, or levers, located in a covered compartment in the floor on the left side of the cockpit, by the pilot's seat.

The landing gear is extended and retracted when the hydraulic actuators are operated under hydraulic pressure. Each leg is powered by one actuator. The hydraulic fluid is contained in a hydraulic system tank and is pressurized by the reversible electric pump.

Photograph 20. Landing gear control panel

The pump is controlled by a lever switch located in the instrument panel in the cockpit (the gear control panel, see Photograph 20), such that when the handle is in the UP or DOWN position, the pump directs fluid through the corresponding pressure lines to each hydraulic actuator. To prevent an undesired retraction, the lever switch must be actuated by pulling out on the handle before it can be pushed into the UP position.

As the fluid pressure rises on one side of the piston in the cylinder, the fluid on the other side is returned to the pump through a different line. Both lines serve as pressure and return lines, depending on the rotation of the pump, in order to raise or lower the gear.

The hydraulic system is equipped with an emergency hydraulic accumulator that is only used to lower the gear and is independent of the normal operation in terms of the hydraulic supply lines to the actuator.

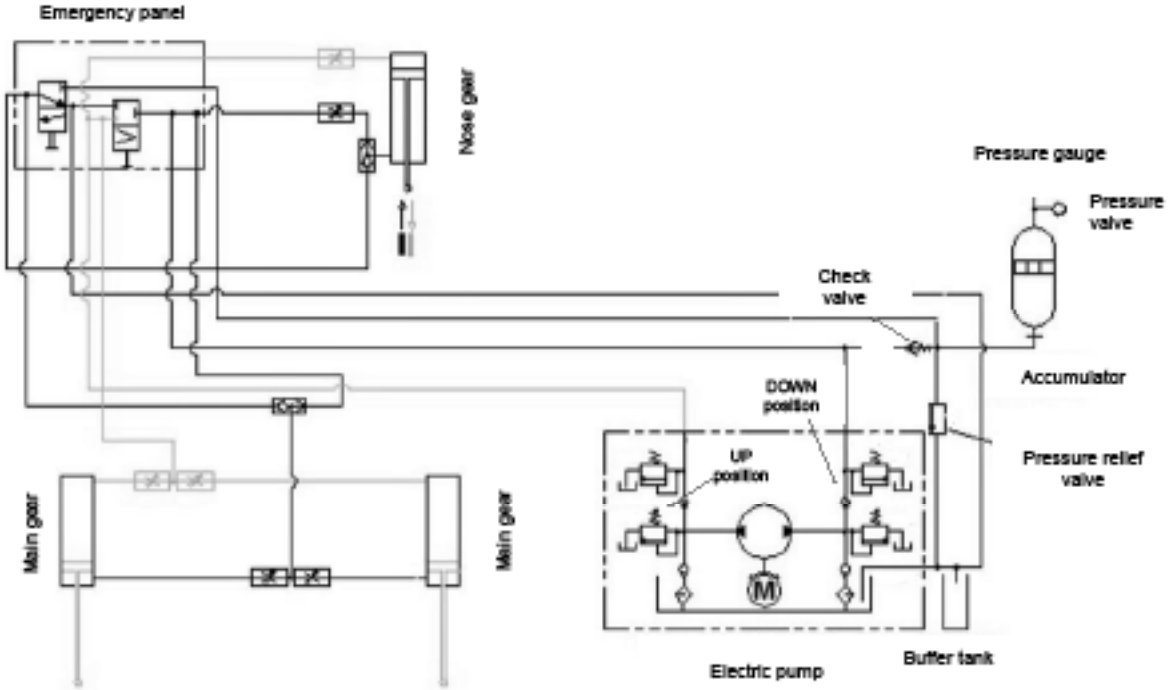


Figure 4. Diagram of the hydraulic system for the landing gear

The normal and emergency extension lines converge, however, in accordance with the selector valves (two valves, one for the nose gear and another for the emergency operation of the main gear).

5.1.2. Landing gear retraction

To retract the gear, the electric pump directly supplies the hydraulic actuators through the pump's UP supply lines. The hydraulic fluid returning from the actuators is routed to the DOWN port on the pump. The restrictors are tasked with synchronizing the legs and limiting their retraction speeds.

During the transit phase, the red TRANS light on the landing gear control panel shows that the gear is moving, and the amber GEAR PUMP ON in the annunciator panel turns on to indicate that the electric gear pump is on.

Once the gear legs are in the UP position, the contacts in the UP position microswitches, one per leg, cut off the power supply to the electric pump. The amber light on the notification panel turns off and the red TRANS light on the control panel also turns off.

Photograph 21. Retracted main landing gear on the incident aircraft

The legs are not locked in the UP position. They are held there by the hydraulic pressure. If the pressure drops, the UP position microswitches would actuate the pump motor and restore the hydraulic fluid pressure before the gear falls from the well under the effect of gravity, or under the effect of the positive load factors that are present during flight.

5.1.3. Gear extension (normal operation)

To lower the gear, the electric pump, now rotating in the opposite direction from before, supplies two lines from the DOWN port on the pump such that, by way of the relevant selector valves and the restrictors that lead to the actuators, the hydraulic fluid moves the posts, allowing the legs to lower.

The hydraulic fluid that returns to the actuators is then routed to the UP port on the pump. The three green lights (one per leg, operated by the lower limit dual-contact microswitches) on the control panel turn on to indicate that the gear is DOWN and LOCKED. The UP and DOWN microswitches control the illumination of the red TRANS light, which indicates the gear is in motion.

Once the gear is down and locked, the microswitches turn off the pump (and, as a consequence, the amber light on the annunciator panel) and the TRANS light. The gear is locked mechanically. During the normal extension operation, a hydraulic line supplies the emergency accumulator through a check valve, restoring the pressure, which will be below the setpoint.

Photograph 22. Inspection cover with pressure reading

Photograph 23.
A: Hydraulic accumulator charging button
B: Relief valve

The pressure gauge for the emergency accumulator is on the left side of the tail cone and is visible through a transparent window on the inspection cover for easy verification, especially during the pre-flight check. The crew can use a red button located under the pressure gauge (accessible by removing the inspection cover) to inhibit the operation of the microswitches and allow the electric pump to charge the accumulator.

The inspection cover has a sign that references the low-pressure limit allowed for the landing gear emergency accumulator. This limit is 20 bar. If the value is below 20 bar during the pre-flight inspection, the system has to be recharged using the aforementioned red button.

The relief valve (accessible from the inspection cover), located at the bottom of the emergency accumulator, protects the accumulator from excessive pressure. If the pressure in the accumulator reaches 40 ± 5 bar, the relief valve opens to lower the pressure to a safe level.

5.1.4. Emergency extension of the gear

The failure of the gear to lower is identified by way of the green lights not turning on. The corresponding leg may not be fully extended or locked. To verify that the fault is not due to a malfunctioning bulb, its correct operation must be verified by pressing the PUSH-TO-TEST button.

The pilot also has to check if the red TRANS light, which indicates that one or more legs are moving, turns on at the same time as the amber GEAR PUMP ON light on the annunciator panel, indicating that the hydraulic gear pump is powered.

If the gear cannot be lowered manually, the emergency gear extension procedure must be used. Under the pilot's seat there is a cover on the floor that identifies the location of the system. The cover conceals a compartment that contains two handles for the emergency extension system that, if required, is activated in accordance with the sequence shown on the placard located inside. The right handle must be actuated first (instruction on the right in the "emergency panel" shown in Photograph 24). This will allow the hydraulic fluid that before the emergency operation was in the actuator chambers ready to retract the gear, to be redirected through the first handle to the hydraulic system tank.

Photograph 24. Emergency gear extension panel

If this tank is full, any excess fluid is collected in a buffer tank (normally empty). Another hydraulic fluid line that comes from the hydraulic accumulator supplies the hydraulic actuators through the first handle (to the left in the "emergency panel" shown in the photograph) and two selector valves.

The gear position indicating lights work as in the normal extension method, which is why the gear control lever must be in the DOWN position before starting the emergency procedure.

5.1.5. Landing gear indicating system

The system that indicates the position of the gear legs is electric and consists of the following main components:

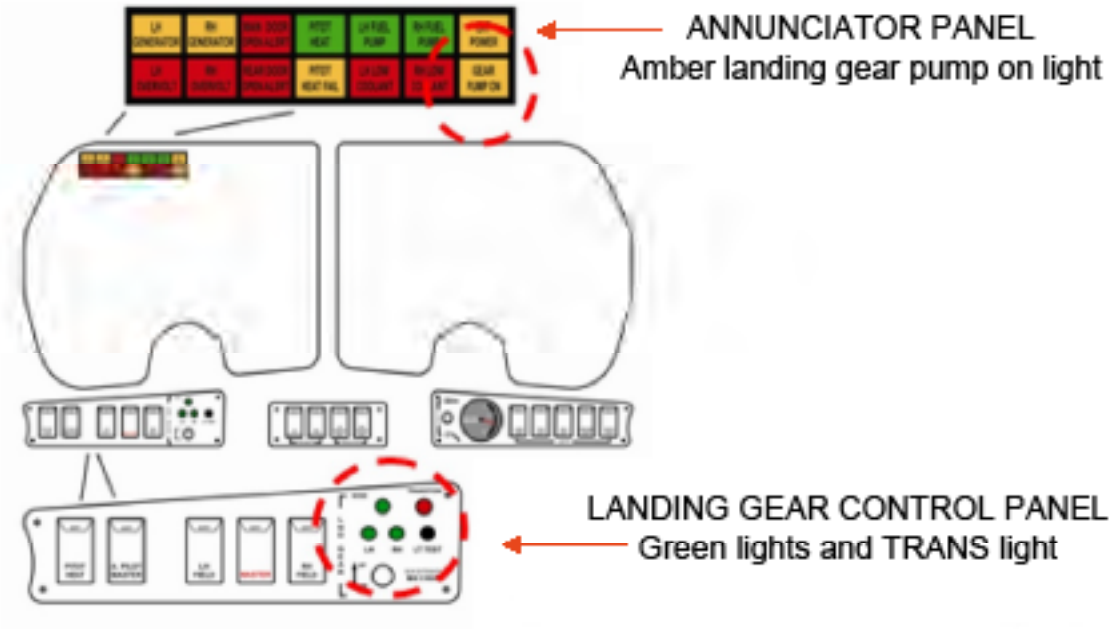
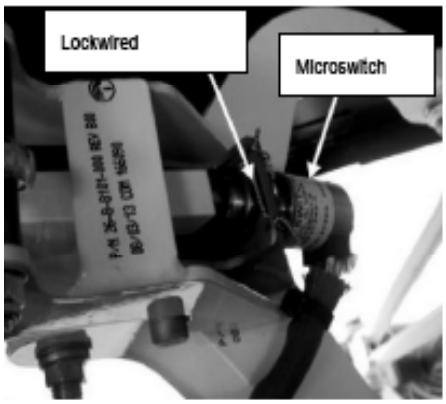


Figure 5. Indicators on the landing gear annunciator panel and control panel.

- 3 green gear indicating lights. If on, they indicate that the gear is down and locked.
- red transit light. If on, it indicates that the gear is moving.
- amber pump light on the annunciator panel. On when the pump is powered.
- UP/DOWN microswitches (6 contacts, two per leg).
- push-to-test button: to test that the red light and 3 green lights are working correctly.

The three green lights are only on when the associated leg is down and locked. The red light indicates that the gear is moving up or down, and the amber light on the annunciator panel indicates that the pump is being powered.

The red transit light only turns off when the gear legs are "down and locked" or "up", while the amber "pump on" light only turns off when the power supply to the electric pump is shut off.



Photograph 25. Position of DOWN microswitch in the NLG

The UP/DOWN microswitches are controlled by the gear configuration specified by the pilot through the gear lever switch, which turns on the corresponding light and actuates the pump.

A push-to-test button on the gear position panel and on the annunciator panel is used to verify that the landing gear lights are operational.

The dual-contact microswitches for the position of the leg are positioned on each leg to detect the DOWN AND LOCKED and UP positions.

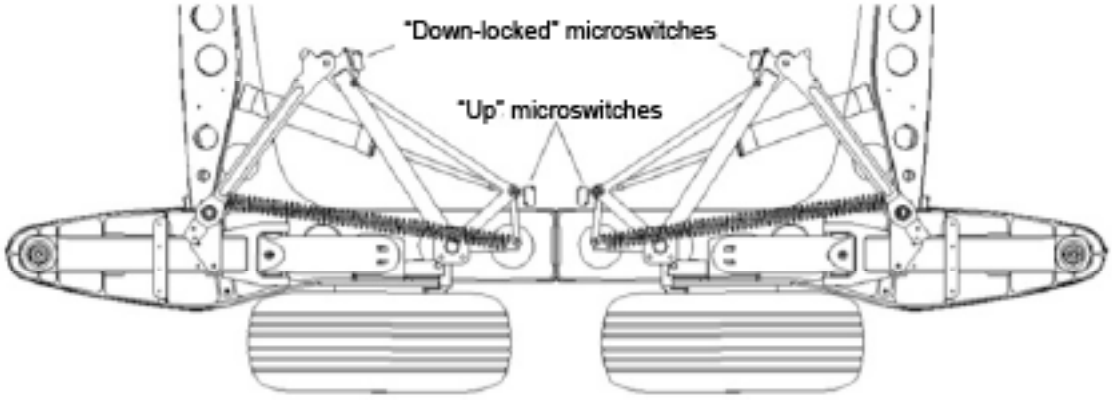
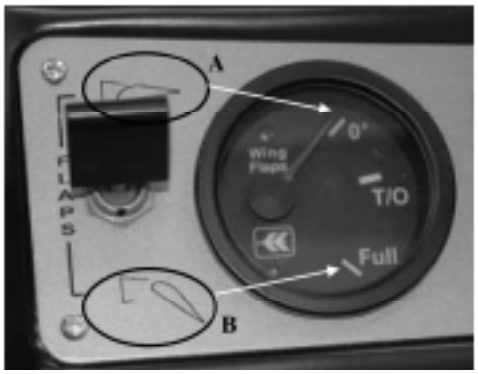


Figure 6. Positions of the microswitches in the MLG

5.1.6. Acoustic warning system

The system is actuated based on the configuration set by the pilot with the throttle levers, the flap position lever and the landing gear.



Photograph 26: Flap control and indication

The acoustic warning system consists of a horn or aural signal that alerts the pilot when the gear lever is in the UP position and at least one of the two throttle levers and/or the flaps are in the IDLE and LAND position, respectively. That is how it is described in the AFM, without specifying if the LAND position for the flaps could mean both the T/O and FULL (land) positions, as shown in the analog flap position indicator on the instrument panel (Photograph 26).

The flaps on this aircraft type are extended by a single electric actuator that is controlled by a switch on the instrument panel that has a continuous range of travel, with no stops for the positions.

The system is designed to generate an aural warning every time the flaps are lowered to the landing position and the gear is not down and locked. The system's sensor is activated by way of a microswitch located at the top of the center cockpit panel, based on the position of the flaps (Photograph 27).

Photograph 27: Flap position microswitch of the gear warning system

5.2. In-flight procedures and checklists

Below are the checklists from in-flight procedures that are of interest to the investigation into this incident, as well as the procedure to use when doing the operational test of the gear that was carried out during the inspection of the aircraft, and the results of which will be detailed in subsequent paragraphs. All of them are in keeping with the contents of the aircraft manufacturer's AFM and AMM.

5.2.1. Pre-flight inspection procedure

The pre-flight tasks associated with the landing gear are provided below:

- Check the main landing gear, first on the left side, verifying the fuselage skin status, tire status (cuts, bruises, cracks and excessive wear), slippage markers integrity, gear structure and shock absorber, hoses, gear door attachments and gar micro-switches. There should be no signs of hydraulic fluid leakage.
- Next, check the gear pump, external power and battery compartment.
- Check emergency landing gear extension system pressure (low pressure limit: 20 bar), external power and battery compartments closure.
- Check the right side of the main gear, verifying the same components as described for the left side.
- Finally, in the nose gear, check the tire status (cuts, bruises, cracks and excessive wear), slippage markers integrity, gear structure and the retraction mechanism, the shock absorber and gear door attachments. There should be no signs of hydraulic fluid leakage.

5.2.2. Before-landing procedure

Checklist:

1. Rear passenger seats: at full aft and lowest position.
2 LH and RH electrical fuel pump: both ON.
3. On downwind leg: Flaps in T/O and VFE = 122 KIAS.
4. Speed below VLO/VLE, landing gear control knob DOWN and check three green indicating lights ON.
5. Carburetor heat: check position.
6. LH and RH propeller lever: FULL FORWARD.
7. On final leg: speed below 93 KIAS. Flaps FULL.
8. Final approach speed: 71 KIAS.
9. Landing and taxi light ON.
10. Touchdown speed: 65 KIAS.

This procedure is used in multiple phases of flight, primarily when landing, but it is also used during maneuvers that have to be completed in the landing configuration and on all approaches. The only thing that changes between these phases is the deployment of the flaps, which is left to the pilot's discretion, and the power, which will be as required for the maneuver to be performed. The final approach speed will thus vary depending on the position of the flaps, and is 90 KIAS for 0º and 80 KIAS for T/O flaps.

5.2.3. Procedure for normal approaches and landings

The procedure includes the following steps:

- Complete the descent and approach checklist.
- Decelerate to a maximum speed of 100 KIAS before joining the relevant traffic pattern.
- When ready to descend to the TPA, place gear lever in DOWN position before verifying landing checklist.
- Descend to TPA at a maximum speed of 84 KIAS.
- During the base leg of the circuit, do the approach checklist.
- During the final leg, decrease speed to a maximum of 71 KIAS and do the final checklist.
- Land and taxi until runway clear, and finally, do the after-landing checklist.

5.2.4. Procedure for missed approaches or balked landings

In the event of a missed approach or go-around, as happened in the incident, for example, due to the appearance of another traffic that is given priority, the steps in the following checklist should be carried out:

1. RH and LH propeller levers: FULL FORWARD.
2. Throttle levers: FULL POWER
3. The AFM has a caution note stating to advance the propeller levers to max RPM after advancing the throttle levers to maximum power, which must be limited to 5 minutes.
4. Flaps: T/O
5. Keep speed over 62 KIAS, climb at V_Y or V_X as appropriate.
6. Landing gear UP as positive climb is achieved.
7. Flaps: 0º.

The landing gear should be retracted when a positive climb rate is ensured at the applicable best speed (VY or VX as appropriate). It has been demonstrated that the best climb rate is always obtained with the flaps in the UP position.

5.2.5. Emergency landing gear extension procedure

If the gear cannot be extended using the normal procedure, the emergency procedure must be used, which involves the following steps:

1. Airspeed: must be below the applicable V_{LO} / $V_{LE.}$
2. Gear control lever: DOWN.
3. Emergency gear extension access door: REMOVE
4. RH control lever: rotate 90º counterclockwise.
5. Wait at least 20 seconds.
   The green lights for the main landing gear legs may turn on, indicating that the legs are down and locked due to the force of gravity alone.
6. LH control lever: rotate 180º counterclockwise.
7. Land as soon as practical.

The emergency landing gear extension operation takes about 20 seconds.

5.2.6. Operational check of the landing gear hydraulic and indication systems

This section provides the instructions for doing a complete operational check of the landing gear system in terms of the normal extension and retraction system, the emergency extension system and the indication and warning system.

There is a 4-6 second difference between the extension of the MLG and NLG, such that the NLG is always the last to extend and the last to retract.

Check the pressure of the emergency accumulator, the minimum value of which is 20 bar. The recommended value is 30 bar. Next, check the operation of the gear position indicating lights using the push-to-test button, which should turn all the lights on when pressed.

The system is checked not only for proper operation, but for smooth operation as well.

To check the normal extension and retraction of the gear, use the following steps. The steps needed to prepare the aircraft beforehand (use of jacks, etc.) are not detailed:

1. Select the gear lever in the cockpit to the UP position. The gear should retract, the green lights should turn off, the red light should turn on, and the amber light as well. Once the retraction is complete, the red light should turn off, the amber light as well and the aural alert should be activated.
2. The LH and RH throttle levers are moved full forward and the aural alert turns off.
3. The LH throttle lever is moved to the IDLE position and the aural alert turns on.
4. The LH throttle lever is moved full forward and the aural alert turns off.
5. The RH throttle lever is moved to the IDLE position and the aural alert turns on.

6. The RH throttle lever is moved full forward and the aural alert turns off.
7. The flaps are moved to the LAND position and the aural alert turns on.
8. The flaps are moved to 0º and the aural alert turns off.
9. The gear control is selected to the DOWN position, the red and amber lights turn on. When the gear extension is complete and the legs are locked, the red and amber lights turn off and the green lights turn on.
10. To check the emergency gear extension system, the corresponding panel in the floor by the pilot's seat is removed and the steps indicated on the placard are carried out. At least 20 seconds must elapse between rotating the right lever to discharge the accumulator and rotating the left one to lower the gear. The red light should turn on. The amber light will remain off. Once the gear is down, the green lights will turn on and the red one will turn off. The delay between the extension of the MLG and the NLG is the same as during normal operation, that is, 4 to 6 seconds.
11. Once the accumulator is discharged, check its nitrogen pressure. If the pressure is below 10 bar, verify that there are no leaks of any kind. Charge nitrogen to a pressure of 11 or 12 bar and wait a minimum of 10 hours. If the accumulator does not hold the pressure, the component is not serviceable and must be replaced.
12. Finally, return the emergency levers to their position and press the red button located under the pressure indicator to have the electric pump charge the accumulator to the proper pressure, shown on the placard, 20 bar minimum, 30 bar recommended.

The following checks can also be performed if a fault is identified in the landing gear actuating pump or if a warning is shown on the annunciator panel window. As stated earlier, if the GEAR PUMP ON amber caution light turns on, this means the pump has electrical power.

It could be the case that the red TRANS light turns off after the gear retraction but the GEAR PUMP ON light stays on. This could indicate a fault with the pump connected relay. Monitor its operation as needed.

If it is not a faulty relay, the fact that the red TRANS light is off and the amber GEAR PUMP ON light is on means that the gear is not locked in the UP position.

A fault in the electric gear pump itself could make it stay electrically powered continuously. This would make it draw a current, which would not affect its operation unless this fault is combined with a general electrical fault, in which case the residual battery life is limited to a maximum of 30 minutes.